

## Introduction and Objective

- Human-made surfaces and structures increase radiant heat exchange in urban areas by several degrees hotter compared to non-urban areas (Chow et al. 2012). Studies have shown negative affects of heat on human health (Petitti et al. 2016), however no studies have focused on the response of wildlife to urban heat.
- Studies compare quantitative magnetic resonance (QMR) scans to carcass analysis and indicate QMR as an accurate measure of fat, lean mass, and water content of rodents (Nixon et al. 2010).
- Animal body condition is storage of resources such as fat, which are important for survival and reproduction (Young 1976).
- The objective of our research is to evaluate rodent body condition living in three levels of urban heat. We tested the hypotheses that percent body fat, lean mass, and water varies in animals from three levels of urban heat.

## Methods

- Selected sites of three levels of temperature based on mean daily summer surface temperatures (A: 47.0 - 49.0° C, B: 50.0 - 52.0° C, and C: 53.0 - 55.0° C).
- We captured 37 adult nocturnal rodents (Merriam's kangaroo rats, *Dipodomys merriami*, and pocket mice, *Chaetodipus spp.*) using baited Sherman live traps from mid-July through early September in urban parks and open spaces.
- QMR machine used to measure fat, lean mass, and water content of live rodents.
- Fat mass (g) was averaged over 12 runs per individual animals' mass from the QMR and then was divided by the animals' measured mass (g).
- Statistical analyses performed using R Version 3.5.2 to evaluate differences in means across temperature levels using an ANOVA (alpha at P = 0.10) and post-hoc comparisons with Tukey test.

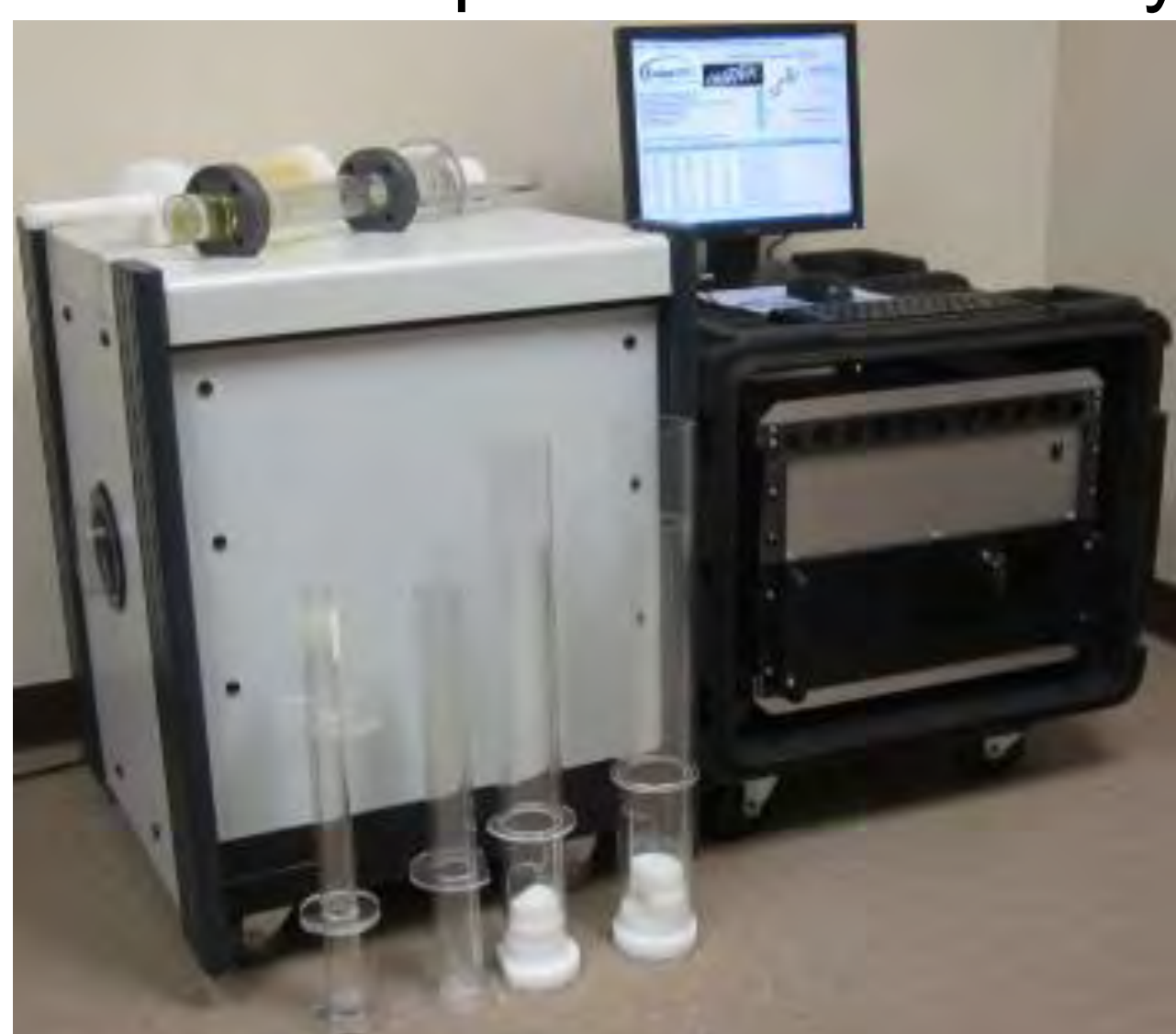


Figure 1. EchoMRI™ Mobile Body Composition Analyzer. Image obtained from echomri.com.

Figure 2. *Chaetodipus spp.* rodent on scrub, McDowell Sonoran Preserve.

## Study Area

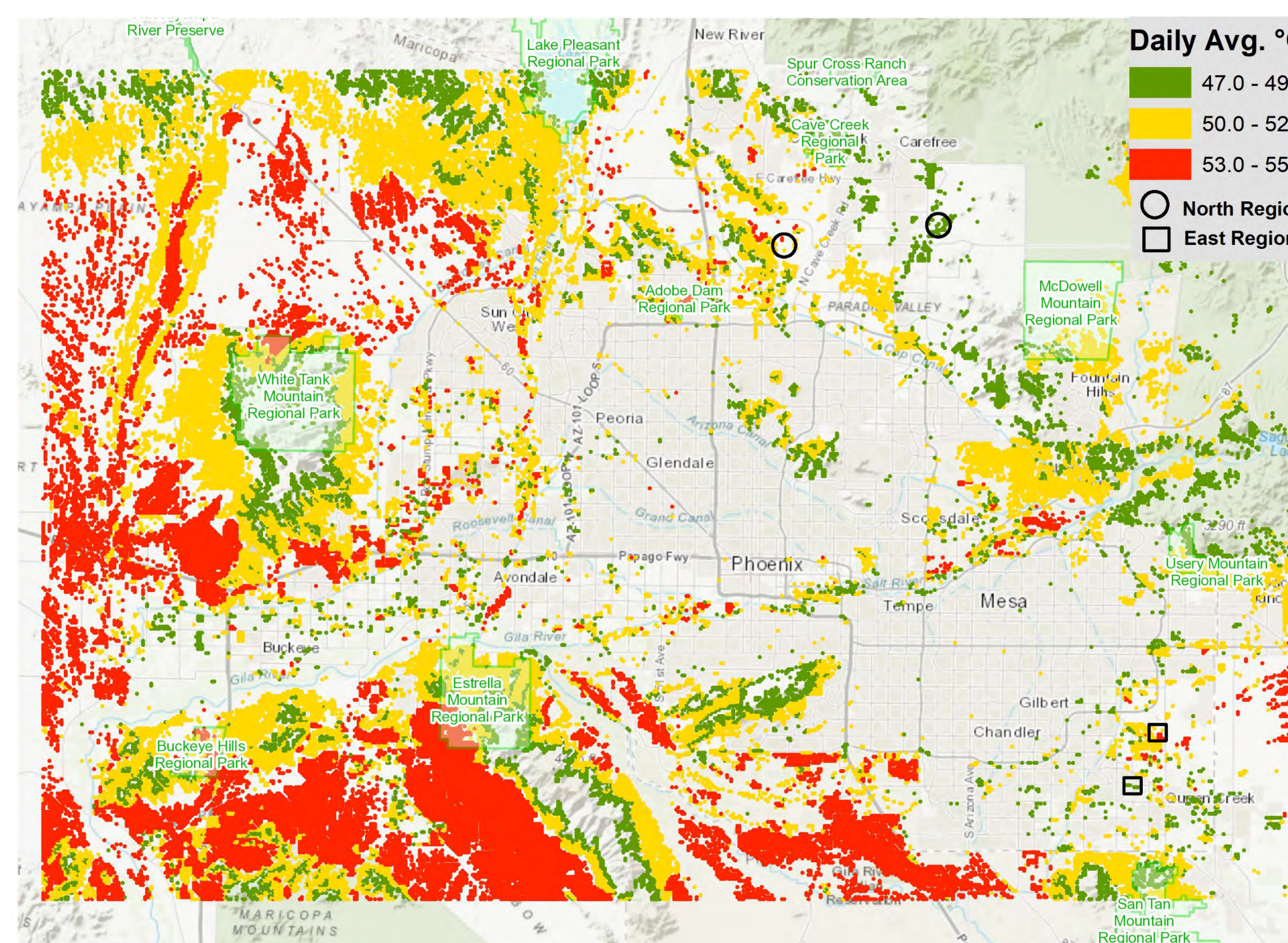


Figure 3. Temperature levels and site locations in two regions across Phoenix, Arizona. Map creation using ArcMap 10.6.1 based on the variation of temperature variations across a heat gradient using the 2010, 15-meter land use and land cover classification data (available from Central-Arizona Phoenix, Long Term Ecological Research program, CAP LTER; Li 2015).

## Results

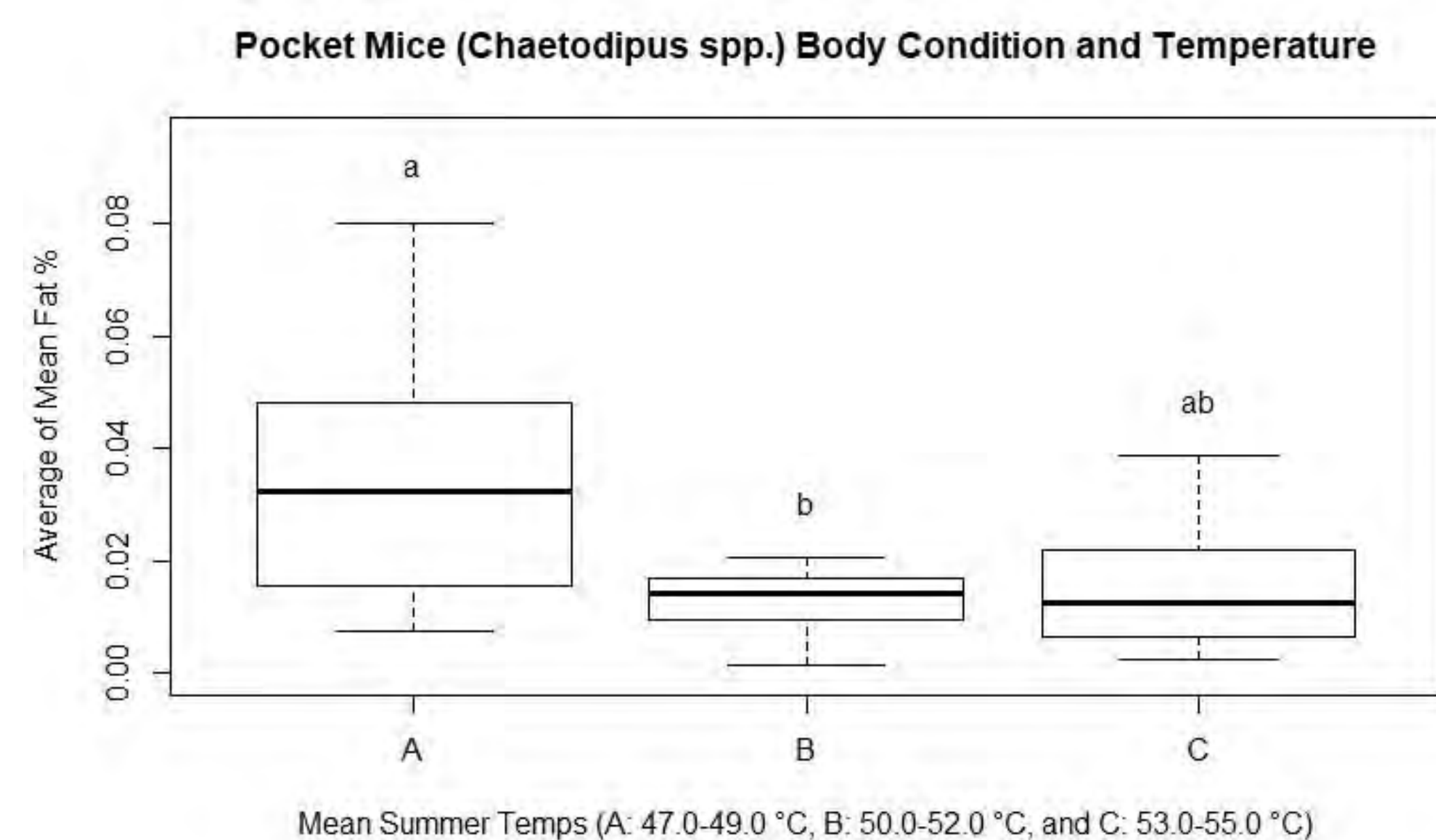


Figure 4. Average of mean fat % of each temperature level for *Chaetodipus spp.*, letters above bar graph symbolize Tukey test results with different letters indicating groups that are significantly different.

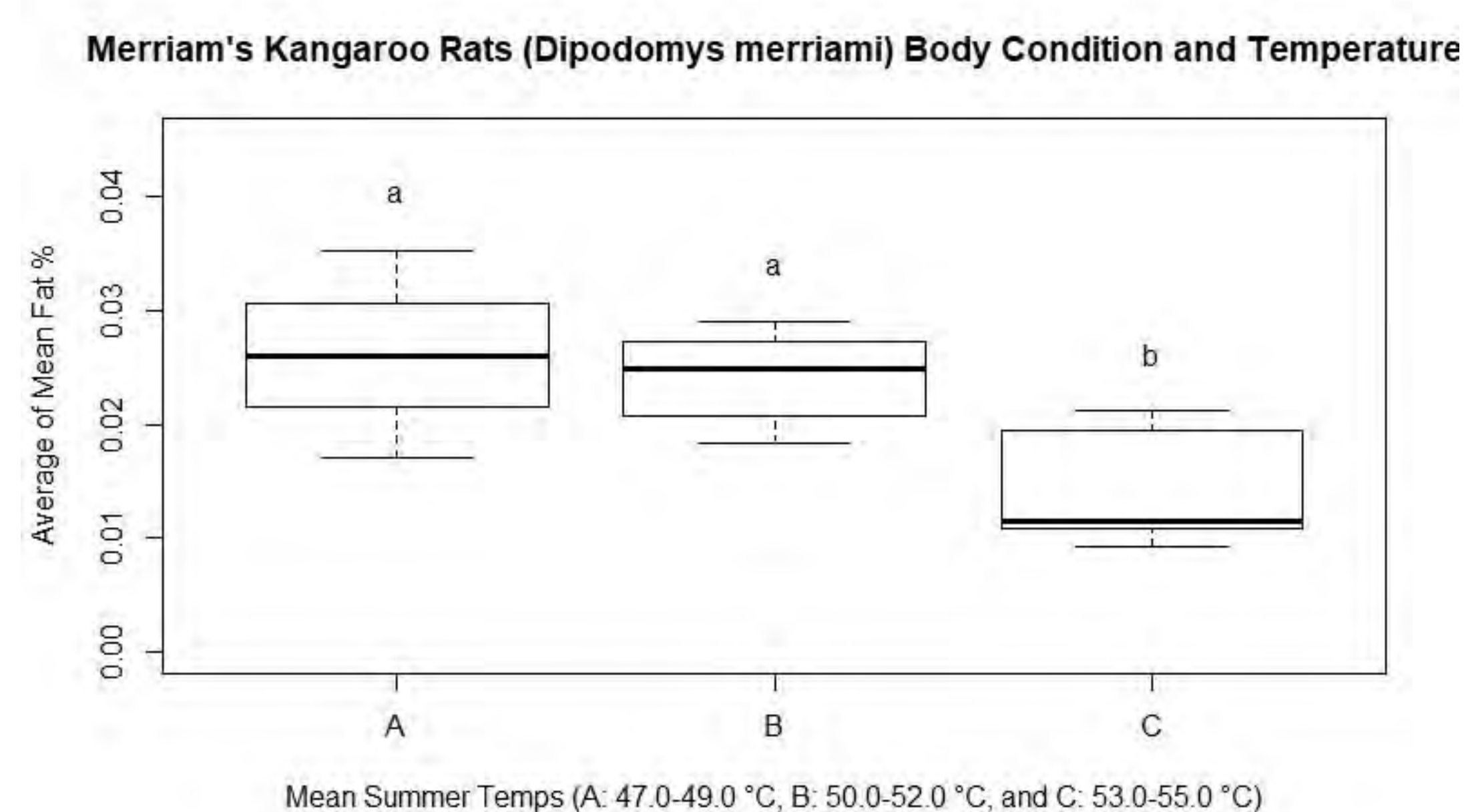


Figure 5. Average of mean fat % of each temperature level for *Dipodomys sp.*, letters above bar graph symbolize Tukey test results with different letters indicating groups that are significantly different.

- The data for site selection and map production is in collaboration with Dr. Hondula.
- Temperature levels (colored areas) represent 400m plots of open area to sample animals from similar habitats.

## Conclusions

- Our preliminary results show pocket mice and Merriam's kangaroo rats captured from cooler summer temperature regimes had more fat than rodents captured from hotter summer regimes.
- Our results will contribute to understanding the effects of extreme heat on urban wildlife body condition and health.
- Implications for management include a better understanding of how wildlife are affected by extreme heat in urbanized areas. We hope this research brings attention to the need to mitigate the effects of extreme heat on urban wildlife and humans.

## Summer 2020

To further investigate the preliminary findings, we plan to:

- Sample additional animals across regions surrounding Phoenix, Arizona
- Expand predictor variable to include vegetation cover, soil type, and land use/land cover

## Acknowledgements

- Gregory Allen, Nicole Holt, Trula Allen Nabors, and Arizona State University student volunteers for help in the field.
- Phoenix-Mesa Gateway Airport and personnel for site permission and access.
- McDowell Sonoran Conservancy and personnel (Tiffany Sprague, Scott Hamilton) for site permission and advice.
- Flood Control District for site permission at Cave Buttes Recreation (CBR) Area, thanks to Dr. Brian Sullivan, Elizabeth Sullivan, and Dr. Jessie Lewis and laboratory for access and field advice at CBR area.
- Animal use permits granted from The Institutional Animal Care and Use Committee (ASU Protocol #: 19-1719R RFC 1) and State of Arizona Game and Fish Department (LIC #SP648546).

## Citations

- Chow, W.T., D. Brennan, and A.J. Brazel. 2012. Urban heat island research in Phoenix, Arizona: Theoretical contributions and policy applications. *Bulletin of the American Meteorological Society* 93(4): 517-530.
- Li, X. 2015. Land use and land cover (LULC) classification of the CAP LTER study area using 2010 Landsat imagery. <https://sustainability.asu.edu/cap/ter/data/view/knb-lter-cap.619.1/>
- Nixon, J.P., M. Zhang, C. Wang, M. Kuskowski, C.M. Novak, J.A. Levine, C.J. Billington, and C.M. Kotz. 2010. Evaluation of a quantitative magnetic resonance imaging system for whole body composition analysis in rodents. *Obesity* 18(8): 1652-1659.
- Petitti, D.B., D.M. Hondula, S. Yang, S.L. Harlan, and G. Chowell. 2016. Multiple trigger points for quantifying heat-health impacts: New evidence from a hot climate. *Environmental Health Perspectives*.124(2): 176-183.
- Young, R.A. 1976. Fat, Energy and Mammalian Survival. *American Zoology*. 16: 699-710.